Wetlands of the Lower Clarence Floodplain, Northern Coastal New South Wales

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The wetlands on the lower Clarence floodplain, on the far north coast of New South Wales, were mapped and described during a detailed survey in 1982. The survey identified 755 wetlands with a total area of about 14,700 ha. Most wetlands were smaller than 10 ha but the relatively few large wetlands made up most of the total area. Open water occupied only 5% of the total wetland area at the time of the survey although some open water occurred in 45% of wetlands. The most important plant families, in terms of extent and frequency of occurrence, were Poaceae (covering 23% of the wetland area, occupying 82% of the total number of wetlands), Cyperaceae (20% area, 36% number), Myrtaceae (17% area, 36% number), Polygonaceae (12% area, 76% number) and Juncaceae (10% area, 75% number). Most wetlands were fringed by dense stands of herbaceous plants but, due to clearing, had few trees on their margins. Ninety-eight percent of wetlands were grazed to some extent and 92% of the total wetland area was affected by drainage. Most wetlands are seasonal with relatively small catchments. Only 28% had catchments on the bedrock slopes surrounding the floodplain. Most catchments have been completely cleared for agriculture. Most wetlands are freehold tenure.

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INTRODUCTION

The coastal wetlands of New South Wales have been mapped and classified in a number of broad-scale surveys. Hannah's (1968) landscape approach dealt mainly with the wetlands of the dune systems and was restricted to the north coast. West *et al.*, (1985) mapped and classified the vegetation of the State's estuarine wetlands. The surveys of Goodrick (1970) and the Coastal Council of New South Wales (1985) were of dunal, estuarine and floodplain wetlands along the whole coast. The Coastal Council study simply delineated wetlands for the purposes of development controls under State Environmental Planning Policy No. 14. Goodrick's survey provided a useful classification based on dominant vegetation and water regime and is the best overview of wetlands on the coastal floodplains. It does not, however, provide sufficiently detailed information on individual floodplain wetlands for conservation or management.

On the Clarence floodplain, none of the previous local, more detailed studies of flora and fauna has covered the wetlands comprehensively. They have concerned only one or a few wetlands and have had a variety of purposes and approaches. For example, Broome (1978) surveyed waterbirds in several areas and two environmental impact statements (Clarence River County Council, 1978, 1980) include vegetation maps and descriptions of some large wetlands. Most other publications on the Clarence floodplain wetlands deal with soils and specific occurrences of birds (Pressey, 1981).

Wetland surveys for the National Parks and Wildlife Service, designed to be both detailed and comprehensive, covered the lower floodplains of the Hunter, Clarence and Macleay Rivers in 1981, 1982 and 1984, respectively, and the coastal lowlands of Tweed Shire in 1986.

The main aims of these surveys were to: plot wetlands with accuracy and, in the

Tweed survey, associated coastal communities on 1:25 000 topo-cadastral maps; describe the wetlands and their catchments from features that could be recorded during a single field visit or remotely from maps and aerial photographs; rank the wetlands for nature conservation, based on a combination of selected criteria.

This paper summarizes the results of the inventory and description of wetlands on the lower Clarence floodplain. Full data, the results of conservation evaluation, and reduced wetland maps have all been incorporated in a consultancy report (Pressey, 1987).

Study Area

The Clarence is one of the major coastal rivers in New South Wales and has an extensive floodplain, some 500 km north-east of Sydney (Fig. 1). The lower Clarence floodplain was defined as alluvium below the 10 m contour, a broad expanse of flood-prone land downstream of the very narrow, upper floodplain. Virtually all of the alluvial wetland area in the Clarence system occurs on the lower floodplain. The survey was also restricted to non-estuarine wetlands (those without saltmarsh and mangroves), although it included brackish areas intermediate between fresh and full tidal waters.

The study area occupies approximately 700 sq. km (Fig. 1). To the north of the river, it extends upstream as far as Whiteman Creek and includes extensive alluvial flats to the north of Grafton, south of Lawrence and around the Broadwater. The major wetland on this side of the river is the Everlasting Swamp. South of the river the survey covered areas downstream of Seelands including large expanses of floodplain between Swan Creek and Tyndale and around Wooloweyah Lagoon. The main wetlands in these areas are the Harrington Lagoon complex, the heavily wooded Shark Swamp and a group of large wetlands on the Coldstream River, one of the Clarence's lower tributaries. The survey also covered Woodford, Harwood and Chatsworth Islands which lie either in the course of the river or in its broad estuary.

Virtually all of the floodplain is cleared for farming. The major agricultural use is grazing of beef and dairy cattle. Sugar cane is an important crop in the eastern parts and relatively small areas are planted with poplars, vegetables and other crops. Drainage of wetlands began soon after European settlement. Around the turn of the century, drainage unions or trusts were formed to enable adjacent landholders to arrange for drainage in co-ordinated systems, with design and construction provided by the Department of Public Works. This work was to promote the growth of vegetation considered valuable as pasture and to encourage closer settlement in the region. From the late 1950s to the 1970s, under flood mitigation schemes, many drains, levees and floodgates were constructed and integrated to exclude floods from certain areas and to accelerate the recession of floodwaters. The alteration of wetlands continued during this period.

Goodrick (1970) found that about 47% of all wetlands in the far north coast region had been destroyed or significantly altered by 1969, mainly by drainage and flood mitigation. About 85% of the total affected area consisted of shallow floodplain wetlands, with more wetland now affected since flood mitigation on the Clarence has continued since Goodrick's survey (Pressey and Middleton, 1982). In addition, many private developments have recently drained and cleared wetlands.

Methods

The units of the survey were discrete wetland basins which were initially identified on black and white aerial photographs as areas of darker tone or as stands of trees. The available aerial photographs were taken between August 1978 and March 1979 and varied in scale from 1:25 000 to 1:40 000. The minimum size for recognition of wetlands

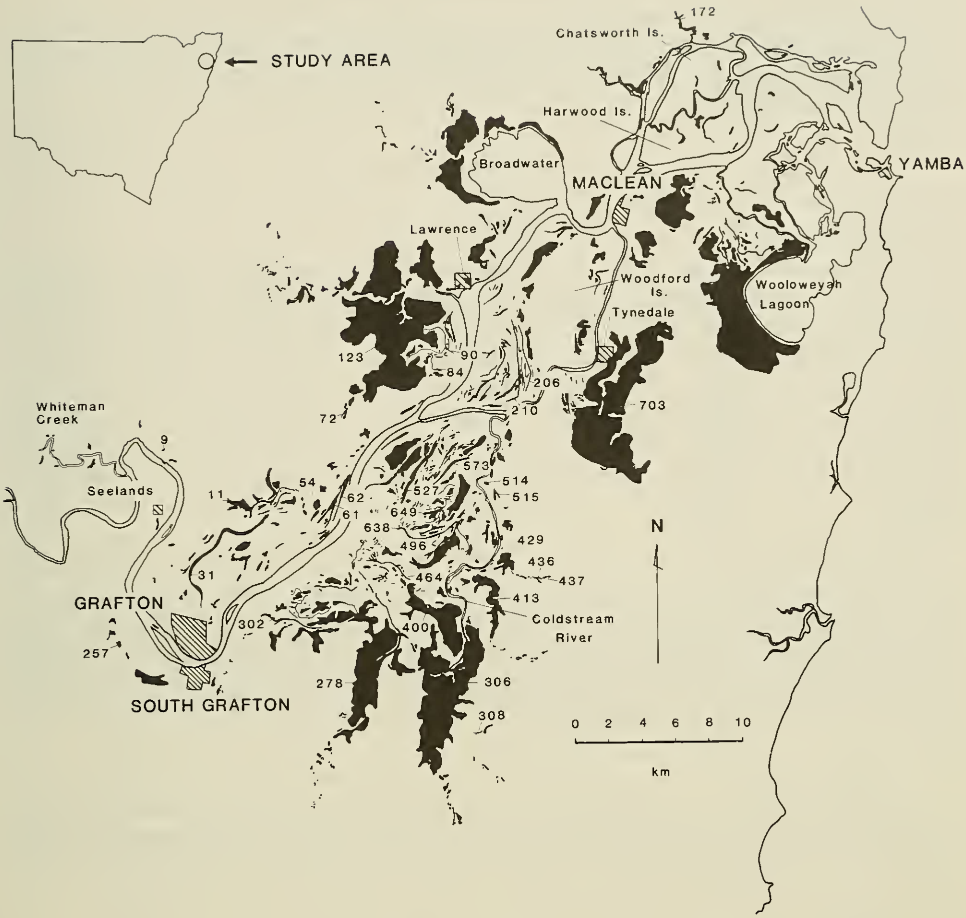

Fig. 1. The study area. Numbers are those given to named wetlands during the survey. The names corresponding to these numbers are: 9 Double Swamp; 11 Bunyip Creek; 31 Alumy Creek; 54 Southgate Lagoon; 61 Southgate Creek; 62 Franks Creek; 72 Long Waterhole; 84 Hannons Lagoon; 90 Harrisons Creek/Coxs Creek; 123 Everlasting Swamp; 172 Mororo Creek; 181 Duckpond Creek; 206 Elbow Creek; 210 Roberts Creek; 257 Cowans Ponds; 278 Cassons Creek/Harrington Lagoon/McLachlan Waterhole; 302 Swan Creek; 306 Ellis Swamp/Crowsnest Swamp; 308 Horseshoe Waterhole; 400 Morans Swamp/Colletts Swamp; 413 Chaffin Swamp; 429 Champions Swamp; 436 Stokes Waterhole; 437 Stokes Waterhole; 464 Sweeneys Creek; 496 Sweeneys Swamp/Oregon Creek; 514 McPhees Swamp; 515 McPhees Swamp; 527 Calliope Creek; 573 Calligans Creek; 638 Alumny Creek; 649 Swampy Creek; 703 Shark Swamp/Tyndale Swamp.

was about 0.1 ha. A few small wetlands of 1 ha or less were omitted because of difficult access.

Final boundaries of wetlands were marked on aerial photographs during a single field visit to each one, either in summer (3.2.82-28.2.82) or winter (19.7.82-17.8.82). These boundaries were later transferred onto 1:25 000 topo-cadastral maps. Scale differences and lens distortion were corrected in the transfer by enlarging or reducing the images on the photographs and by matching features such as fencelines, roads and drains between photographs and maps over small areas.

The number and types of attributes recorded for each wetland were constrained by the time available. In particular, fauna could not be described reliably, and faunal habitat and importance in each wetland were generally inferred from open water and the type and structure of vegetation.

Of the twelve attributes listed for each wetland, five were used solely for ranking the wetlands for conservation (see Pressey, 1987). The remaining seven were used descriptively and are as follows.

i) *Size*

Size of wetlands was estimated from corrected boundaries on topo-cadastral maps using a dot grid.

ii) *Vegetation/habitats*

Vegetation and faunal habitat of the wetlands were described by plant species or genera and two categories of open water: deep (>60 cm) and shallow <60 cm). Authorities for plant names are those in Jacobs and Pickard (1981) as amended by Jacobs and Lapinpuro (1986), unless indicated otherwise. Water depth was judged from fence-lines and from the slope of the bed. Submerged plants were not recorded, nor were species from the families Azollaceae or Lemnaceae. The percentage of each wetland occupied by each taxon or open water category was estimated by eye in the field. Percentages were later converted to absolute areas when the sizes of wetlands were measured. Taxa or open water categories occupying less than 0.1 ha in a wetland were listed only as present.

Small wetlands were described by walking through or around them, large swamps by walking through them, by scanning with binoculars from vantage points, and by visiting areas with distinctive tone or texture on aerial photographs. Some inconsistencies in description would have resulted from differences in sampling intensity between wetlands. The accuracy of estimates of the percentages of wetland areas occupied by plant taxa and open water categories would probably be inversely related to wetland size.

iii) *Marginal vegetation*

Vegetation on wetland margins was rated in the field according to the percentage of perimeter lined with trees or emergents (rushes, tall herbs or grasses) and the average density and width of the fringing emergent band. Fringing plants not typical of wetlands, such as tall pasture grasses, were not taken into account as emergents.

iv) *Alteration*

Signs of obvious alteration such as grazing, drainage and impoundment were recorded in the field and from aerial photographs.

v) *Catchment areas*

Wetland catchments were categorized according to whether they were completely on alluvial flats or at least partly on bedrock slopes. Catchments on bedrock above the 10 m (lowest) contour were delineated and their areas measured on topographic maps.

vi) *Catchment land use*

Broad types of land use in wetland catchments were recorded in the field and from maps and aerial photographs. They were listed for each catchment in order of the proportion occupied. Categories recognized were agriculture (including grazing and cropping), forestry, industrial areas, mining (only surface extraction of sand, gravel etc. in the case of the Clarence survey area), natural vegetation, urban areas and waste disposal (including sewage treatment works).

vii) *Tenure*

Land tenure, easements and any other relevant land designations were listed for each wetland in order of the proportion of the wetland affected.

Results and Discussion

The survey covered 755 wetlands with a total area of 14,728 ha. The majority of wetlands are small (Table 1), 88% of them 10 ha or less in size. These small wetlands account for only 9% of the total wetland area. The bulk of the wetland area (77%) is made up by the relatively small number of wetlands (3% of total number) greater than 100 ha in size.

Table 1

Size distribution of wetlands

Area (ha)	No. of wetlands	% Total no.	Wetland area (ha)	% Total area
0-1.0	343	45.4	174.5	1.2
1.1-5.0	255	33.8	626.6	4.3
5.1-10.0	69	9.1	480.4	3.3
10.1-50	57	7.6	1155.4	7.8
51-100	12	1.6	878	6.0
101-500	13	1.7	2713	18.4
501-1000	1	0.1	520	3.5
>1000	5	0.7	8180	55.5
	755	100.0	14,727.9	100.0

Seventy-three plant taxa were systematically recorded. Their occurrence in the study area, with that of the two recorded categories of open water, is summarized in the Appendix. Some plants were identified only to genus. The most common of these were:

— *Juncus* spp. refers to species in the Section Genuini, the relative areas of which were not determined. The only two species identified were *J. usitatus* and *J. polyanthemus*. From subsequent work on the Macleay floodplain, it is likely that hybrids of these species are common and widespread.

— *Persicaria* spp. were not recorded individually. Species collected during the survey were *P. hydropiper* (most extensive), *P. lapathifolia*, *P. strigosa* and *P.* sp. B. Another species occurring in the area but not found in the wetlands surveyed is *P.* sp. A.

— *Typha* spp. were also combined. Both *T. domingensis* and *T. orientalis* occur in the area, with the latter species by far the more common.

Open water was relatively unimportant in terms of the overall area occupied (Appendix). Shallow open water was more extensive and more commonly recorded than deep open water. Goodrick (1970) recorded a relatively small area of wetlands dominated by open water on the far north coast generally. The floodplain wetlands in this region, including those of the Clarence, are largely in the five categories of Goodrick's classification that are dominated by herbaceous emergents or by trees: fresh meadows, seasonal fresh swamps, semi-permanent fresh swamps, teatree swamps and reed swamps (Table 2). Wetlands in these categories contain relatively little open water.

Of the plant taxa recorded, the monocotyledons accounted for nearly 59% of the total wetland area and dicotyledons about 35% (Appendix). Monocots occurred in 97% of wetlands and dicots in 89%. The most extensive and commonly recorded monocot families were Poaceae (23% of wetland area, 82% of wetland number), Cyperaceae (20% area, 36% number) and Juncaceae (10% area, 75% number). *Paspalum distichum* (water couch) dominated the area occupied by the Poaceae and was the most commonly recorded grass. *Eleocharis equisetina* was the commonest and by far the most extensive member of the Cyperaceae. The most extensive and commonly recorded dicot families were Myrtaceae (17% of wetland area and 36% of wetland number) and Polygonaceae

(12% area, 76% number). *Melaleuca quinquenervia* was the most extensive dicot species, occupying 17% of the total wetland area. *Casuarina glauca* was the most commonly recorded dicot species, occurring in 33% of wetlands, although it is likely that most or all of the 76% of wetlands containing *Persicaria* spp. contained *P. hydropiper.*

TABLE 2

Extent and decline of wetland types on the far north coast of New South Wales (modified from Goodrick, 1970)#

Wetland type	Original area (ha)	1969 area (ha)	% Decline
fresh meadows	22680	(2150)	59.4
seasonal fresh swamps		(7050)	
semi-permanent fresh swamps	360	320	11.1
open fresh waters*	450	450	–
teatree swamps	4010	2390	40.4
salt meadows	1380	1380	–
reed swamps	1460	730	50.0
salt flats	530	530	–
mangrove swamps	1860	1780	4.3
coastal bogs	570	570	–
coastal *Lepironia* swamps	320	320	–
	33620	17670	47.4

\# estimates excluded two wetland types: shallow estuarine waters and sheoak swamps.
* open fresh waters is the only floodplain wetland category identified by Goodrick as being dominantly open water, although relatively small areas of open water occur in other categories on the Clarence floodplain.
Underlined categories are those occurring on the Clarence floodplain.

Cyperaceae and Poaceae were the most diverse families, with 24 and 12 species respectively, together representing nearly half the total plant taxa. Most plant taxa occurred in relatively few wetlands and occupied only small percentages of the total wetland area (Table 3). The maximum number of native plant taxa recorded in a wetland was 31, although most wetlands contained relatively few (Table 4).

Four recorded plant species are introduced: *Salvinia molesta*, *Echinochloa crus-galli*, *Nymphaea capensis* and *Eichhornia crassipes* (water hyacinth). At the time of the survey, these covered about 1.9% of the total wetland area. Water hyacinth was by far the most extensive of these, occupying some 250 ha, and had completely blanketed and infilled some wetlands.

Several native species, such as *Eucalyptus robusta*, *Juncus kraussii*, *Sporobolus virginicus* and *Triglochin striata*, occur only marginally in floodplain wetlands and are more typical of other wetland types.

The survey provided records of some rare or uncommon plant species. These include:

– *Brasenia schreberi* (Cabombaceae): present in 1 wetland; very few records for coastal New South Wales; listed as 3V by Briggs and Leigh (1988);
– *Cyperus odoratus* (Cyperaceae): present in 2 wetlands; very few records for the state;
– *Cyperus platystylis* (Cyperaceae): present in 1 wetland; a plant of floating organic mats in northern Australia and a very rare plant in New South Wales (K. Wilson, Natnl. Herb. N.S.W., pers. comm.); found on a mat of water hyacinth;
– *Eleocharis philippinensis* (Cyperaceae): present in 1 wetland; only one previous record for the state;

TABLE 3

Frequency of occurrence of plant taxa in wetlands according to % number of wetlands and % total wetland area (bracketed figures indicate number of introduced species in percentage classes)

Percentage class	No. taxa (% no. wetlands)	No. taxa (% wetland area)
0-1.0	28(2)	57(3)
1.1-2.0	9	5(1)
2.1-3.0	5	2
3.1-4.0	1	2
4.1-5.0	8	1
5.1-6.0	2	–
6.1-7.0	2	–
7.1-8.0	2(1)	–
8.1-9.0	–	–
9.1-10.0	1	1
10.1-20	8	4
21-30	1	–
31-40	2(1)	–
41-50	–	–
51-60	–	–
61-70	–	–
71-80	3	–
81-90	–	–
91-100	–	–

TABLE 4

Numbers of native plant taxa in wetlands

Taxa	No. wetlands	% Total no.
>20	5	0.7
16-20	10	1.3
11-15	49	6.5
6-10	171	22.6
0-5	520	68.9
	755	100.0

— *Maundia triglochinoides* (Juncaginaceae): present in 34 wetlands over a total area of 13.5 ha; known range only on the east coast between Wyong and the Brisbane area (Aston, 1973; Sainty and Jacobs, 1981); considered rare on the New South Wales central coast by Beadle *et al.* (1982); generally rarely reported and of uncertain status (S. Jacobs, Natnl. Herb. N.S.W., pers. comm.).

Despite dry conditions over most of New South Wales in 1982, the results of the botanical survey should be generally representative of the Clarence floodplain wetlands. Good rains preceded the February survey when wetland vegetation was well developed and most basins were full or nearly so. However, some plants would have been missed or underestimated during the winter part of the survey because of seasonal growth patterns, absence of inflorescences, or the drier conditions typical of winter in the area.

The majority of wetlands had few trees on their margins (Table 5), a result of the widespread clearing of the floodplain. Fringing herbaceous emergents were, however, generally well developed in terms of density, width and the average percentage of perimeters occupied. The major taxa classed as fringing emergents were *Juncus* spp. and *Persicaria* spp. Others were *Carex appressa*, *Leersia hexandra* and *Lepironia articulata*. *Casuarina glauca* and *Melaleuca quinquenervia* were the most common fringing trees.

TABLE 5

Summary of records for condition of marginal vegetation

A Percentage of perimeter with trees			B Percentage of perimeter with emergent vegetation		
Percentage	No. wetlands	% Total no.	Percentage	No. wetlands	% Total no.
91-100	44	5.8	91-100	410	54.2
66-90	36	4.8	66-90	79	10.5
36-65	58	7.7	36-65	74	9.8
10-35	65	8.6	10-35	42	5.6
0-9	552	73.1	0-9	150	19.9
	755	100.0		755	100.0

C. Average density and width of emergent vegetation

Rating	No. wetlands	% Total No.
5 (very dense and wide)	331	43.8
4	69	9.1
3	122	16.2
2	76	10.1
1 (very sparse and narrow)	157	20.8
	755	100.0

About 98% of the total number of wetlands were grazed to some extent. Drainage had directly affected 295 wetlands (39% of total number) and a wetland area of 13,500 ha (92% of total area). Drainage has reduced the persistence and depth of standing water in these wetlands with consequent changes in the distribution and abundance of plants and animals. The severity of drainage effects has varied depending on the depth of drains, the original nature of the wetlands, and the extent of their catchments. The overall effects of drainage on the Clarence floodplain wetlands are probably underestimated by these statistics for two reasons. Firstly, drainage may have lowered local water tables and so affected wetlands not directly drained. Secondly, drainage has fragmented some previously large wetlands into remnant sub-basins that are not directly drained but have had their water regimes altered.

Few, if any, wetlands on the Clarence floodplain have been completely eliminated by drainage. The main reason for the inconsistency between this statement and Goodrick's (1970) estimates of the decline of fresh meadows and seasonal fresh swamps in the region (Table 2) is that Goodrick's survey was primarily concerned with waterfowl habitat. His estimates of the decline of wetlands therefore included any areas whose value to waterfowl had been largely eliminated. Many such areas, though, can still be defined by wetland vegetation.

Wetlands were placed in two broad hydrological categories on the basis of the nature of their catchments. The first (Category 1) comprises 544 wetlands with an area of 2456 ha (72% total number, 17% total area) which have small catchments confined to alluvial flats below the 10 m contour. Their water levels would generally be less stable and would fall more quickly during dry periods than those in other wetlands.

The second type of wetlands (Category 2) have catchments extending above the 10 m contour beyond the alluvial flats on which they occur. This category includes 211 wetlands with a total area of some 12,272 ha (28% of total number, 83% of total area). Most of these wetlands have catchments smaller than 1000 ha although most of the wetland area in Category 2 is filled from larger catchments (Table 6). The largest catchment area, that of Ellis Swamp and Crowsnest Swamp (No. 306 in Fig. 1), is 17,200 ha. Most also have ratios of catchment area/wetland area of less than 100 and nearly 80% of the wetland area in Category 2 has a ratio of 10 or less (Table 7). Wetlands with large catchments and with large ratios of catchment area/wetland area will generally have more persistent and stable water levels and will contract more slowly in dry periods. At least some of these would be important local foci for fauna during droughts and may be significant in a broader context, particularly for the more mobile species of waterbirds.

TABLE 6

Catchment sizes for wetlands with catchments above the 10 m contour (Category 2)

Catchment size (ha)	No. wetlands	% Total no. Cat. 2	Wetland area (ha)	% Total area Cat. 2
0-10	62	29.4	112.4	0.9
11-100	66	31.3	421.3	3.4
101-1000	44	20.8	2566.8	20.9
>1000	39	18.5	9171.4	74.7
	211	100.0	12272.9	100.0

TABLE 7

Ratios of catchment area/wetland area for wetlands with catchments above the 10 m contour (Category 2)

Catchment/ wetland ratio	No. wetlands	% Total no. Cat. 2	Wetland area	% Total area Cat. 2
0-10	106	50.2	9433.0	76.8
11-100	66	31.3	2722.8	22.2
101-1000	26	12.3	95.0	0.8
>1000	13	6.2	21.1	0.2
	211	100.0	12271.9	100.0

Twenty-one combinations of land uses were recognized in wetland catchments. The occurrence of each broad land use is summarized in Table 8. Agriculture is by far the major catchment land use, although areas of natural vegetation are also relatively common. Seventy-seven percent of catchments are completely under agriculture, and nearly all of these are restricted entirely to the alluvial flats. Only two catchments are completely covered by natural vegetation.

TABLE 8

Land use occurrence in wetland catchments

Land use	Present (% no. catchments)	Dominant or sole use (% no. catchments)
Agriculture	99.7	87.3
Forestry	5.7	1.1
Industrial area	0.5	—
Mining	3.2	—
Natural vegetation	21.3	11.5
Urban area	3.0	0.1
Waste disposal	0.5	—

In 95% of wetlands, land tenure is solely or dominantly freehold. One wetland (Cowans Ponds, No. 257 in Fig. 1) is within a Wildlife Refuge under the National Parks and Wildlife Act, 1974.

The survey reported here is the first comprehensive and detailed description of wetlands on the Clarence floodplain. However, the results are accurate for the wetlands and their catchments only for the period of the field survey and for the dates of the aerial photography. Subsequent developments and changes in land use will have affected and will continue to affect the condition of many wetland catchments, the condition of marginal vegetation, and the occurrence of plant taxa and open water. In particular, the future applicability of the data on plants and open water categories will depend on the extent of short-term irregular and long-term successional changes in the wetlands. The nature of these changes is difficult to predict with the presently poor understanding of the dynamics of Australian wetlands. Nevertheless, general observations by the author over several years on the Clarence floodplain suggest that:

- the distribution and abundance of plant taxa in some wetlands alter over periods of months or years, although the suites of plant species in these areas generally remain similar;
- the distribution and abundance of plant taxa in other wetlands, particularly those which are seasonal and have small catchments, appear to change very little over months or years.

Without research on the vegetation dynamics of these areas, the characteristics of the wetlands that determine variability or stability of plant distributions, and the nature and extent of short-term variability, must remain conjectural.

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APPENDIX

Occurrence of open water categories and plant taxa (indicates introduced species; + indicates no occurrence greater than 0.1 ha; ns indicates less than 0.1%)*

Taxon/open water category	No. wetlands	% Total no.	Total area (ha) occupied	% Total wetland area
Shallow open water	317	42.0	554.5	3.8
Deep open water	91	12.1	315.5	2.1
Total open water	**337**	**44.6**	**870**	**5.0**
PTERIDOPHYTES				
BLECHNACEAE				
Blechnum indicum Burm.f.	10	1.3	+	ns
MARSILEACEAE				
Marsilea mutica Mett.	31	4.1	11.4	0.1
SALVINIACEAE				
**Salvinia molesta* D. S. Mitchell	3	0.4	2	ns
Total Pteridophytes	**43**	**5.7**	**13.4**	**0.1**
MONOCOTYLEDONS				
ALISMATACEAE				
Damasonium minus	2	0.3	+	ns
CYPERACEAE				
Baumea articulata	7	0.9	+	ns
Bolboschoenus ? caldwellii	2	0.3	25.2	0.2
B. fluviatilis	21	2.8	3.8	ns
Carex appressa	52	6.9	24.6	0.2
Cladium procerum	4	0.5	2.1	ns
Cyperus exaltatus	33	4.4	2.4	ns
C. haspan	5	0.7	+	ns
C. odoratus	2	0.3	+	ns
C. pilosus	1	0.1	0.5	ns
C. platystylis	1	0.1	+	ns
C. polystachyos	37	4.9	17.7	0.1
C. sanguinolentus	3	0.4	+	ns
Eleocharis dietrichiana	48	6.4	4.1	ns
E. equisetina	110	14.6	2118	14.5
E. telmatophila	9	1.2	0.2	ns
Leersia hexandra	56	7.4	24.2	0.2
Panicum paludosum	2	0.3	+	ns
(1) *Panicum/Pseudoraphis*	152	20.1	309.4	2.1
Paspalum distichum	569	75.4	2211.5	15.0
P. vaginatum	8	1.1	344.7	2.3
Phragmites australis	31	4.1	455	3.1
Sacciolepis indica	2	0.3	+	ns
Sporobolus virginicus	4	0.5	14	0.1
Total Poaceae	**622**	**82.4**	**3364.5**	**22.9**
PONTEDERIACEAE				
**Eichhornia crassipes*	266	35.2	246.7	1.7
POTAMOGETONACEAE				
Potamogeton tricarinatus	31	4.1	6	ns
TYPHACEAE				
Typha spp.	29	3.8	24	0.2
Total Monocotyledons	**733**	**97.1**	**8627.1**	**58.6**
DICOTYLEDONS				
APIACEAE				
Lilaeopsis polyantha	5	0.7	+	ns
ASTERACEAE				
Cotula coronopifolia	9	1.2	10.5	0.1
CABOMBACEAE				
Brasenia schreberi	1	0.1	+	ns
CASUARINACEAE				
Casuarina glauca	250	33.1	601.8	4.1
HALORAGACEAE				
Myriophyllum latifolium	23	3.0	3.4	ns

APPENDIX (continued)

Taxon/open water category	No. wetlands	% Total no.	Total area (ha) occupied	% Total wetland area
E. minuta	83	11.0	146.5	1.0
E. philippinensis	1	0.1	0.1	ns
E. sphacelata	98	13.0	168.7	1.1
Fimbristylis ferruginea	2	0.3	+	ns
F. nutans	3	0.4	+	ns
Isolepis inundata	10	1.3	26.4	0.2
Lepironia articulata	45	6.0	189.8	1.3
Schoenoplectus litoralis	17	2.3	203.7	1.4
S. mucronatus	9	1.2	0.2	ns
S. validus	5	0.7	+	ns
Total Cyperaceae	**274**	**36.3**	**2933.8**	**19.9**
ERIOCAULACEAE				
Eriocaulon scariosum	3	0.4	+	ns
HYDROCHARITACEAE				
Ottelia ovalifolia	40	5.3	1.7	ns
JUNCACEAE				
Juncus kraussii	7	0.9	15.1	0.1
J. prismatocarpus	32	4.2	2.2	ns
Juncus spp.	557	73.8	1395.9	9.5
Total Juncaceae	**565**	**74.8**	**1413.2**	**9.6**
JUNCAGINACEAE				
Maundia triglochinoides	34	4.5	13.5	0.1
Triglochin procera	95	12.6	22	0.1
T. striata	11	1.5	24	0.2
Total Juncaginaceae	**129**	**17.1**	**59.5**	**0.4**
PHILYDRACEAE				
Philydrum lanuginosum	74	9.8	577.7	3.9
POACEAE				
Diplachne fusca	1	0.1	0.5	ns
**Echinochloa crus-galli*	2	0.3	5	ns
LOBELIACEAE				
Isotoma ? armstrongii	1	0.1	0.3	ns
I. fluviatilis	1	0.1	+	ns
Isotoma sp.	6	0.8	+	ns
Total Lobeliaceae	**8**	**1.1**	**0.3**	**ns**
MENYANTHACEAE				
Nymphoides geminata	9	1.2	1.3	ns
N. indica	38	5.0	39.5	0.3
Total Menyanthaceae	**45**	**6.0**	**40.8**	**0.3**
MYRTACEAE				
Callistemon salignus	21	2.8	1.2	ns
Eucalyptus robusta	3	0.4	6.1	ns
Leptospermum juniperinum	3	0.4	5	ns
Melaleuca linariifolia	117	15.5	62.8	0.4
M. quinquenervia	140	18.5	2479.3	16.9
M. styphelioides	79	10.5	3.9	ns
Total Myrtaceae	**273**	**36.2**	**2558.3**	**17.3**
NYMPHAEACEAE				
**Nymphaea capensis*	58	7.7	25.2	0.2
N. gigantea	10	1.3	13	0.1
Total Nymphaeaceae	**63**	**8.3**	**38.2**	**0.3**
ONAGRACEAE				
Ludwigia peploides	119	15.8	31.9	0.2
POLYGONACEAE				
Persicaria spp.	574	76.0	1705.0	11.6
SCROPHULARIACEAE				
Bacopa monnieri	19	2.5	227.2	1.5
Total Dicotyledons	**669**	**88.6**	**5217.4**	**35.4**
SURVEY TOTAL			**14727.9**	**100.0**

(1) *Panicum obseptum* and *Pseudoraphis spinescens* were not always reliably distinguished. *Panicum obseptum* was by far the more extensive and commonly recorded.